Valerie Gray 8/28/2018
DNREC – Division of Air Quality
Subject: 1147 Public Hearing 8/29/18
100 Water Street, Suite 6A
Dover, DE 19904

Dear Ms. Gray,

The following objections are submitted in response to filed proposed regulation DE Admin. Code 1147 - CO_2 Budget Trading Program, known commonly as the Regional Greenhouse Gas Initiative (RGGI), in the Delaware Register of Regulations August 1, 2018.

Summary

Delaware met Governor Carney's carbon dioxide emission reduction goal of 28% from 2005 by 2025 in 2017, making an extension of the RGGI program to 2030 unnecessary. The RGGI extension most likely will lead to the export of emissions to other states with no positive global impact through the export of electric generation, and manufacturing jobs. Lower in-state power generation may reduce electric grid reliability. Higher electric rates may harm economic growth. An honest Regulatory Impact Analysis would likely show the costs exceed the benefits of this regulation. This regulation should be canceled.

Errata

Section 5.1.9 annual base budget for 2026 appears to be a typographical error and should be 2,820,690 tons instead of 2,280,690 tons.

Further CO_2 reductions are not required to meet stated Delaware emission goals

Delaware has met stated CO_2 reduction goals by any measure, and no further reductions are needed. Therefore, the proposed regulation is superfluous. Governor Carney joined the U.S. Climate Alliance whose stated goals are to reduce 2005 emissions by 26% to 28% by 2025 to meet the goals of the Paris Agreement. Besides the fact the U.S. has announced plans to pull out of the agreement, Delaware met the 2025 goal in 2017. The only regulation proposed by the Obama Administration to meet the goal was the final 2015 Clean Power Plan proposed by the Environmental Protection Agency (EPA) which was stayed by the Supreme Court, and is in the process of being revised/repealed. Under the proposed CPP the mass based power plant emissions goal for Delaware in 2030 was 3,276,069 short tons, and Delaware power plants only emitted 3,244,029 tons in 2017, according to RGGI COATS. Delaware power plants emitted 8,300,628 tons of CO_2 in 2005, so emissions were reduced 61% compared to a 28% goal.

Compared another way <u>total</u> energy based emissions were 17.4 million tons in 2005, according to the U.S. Energy Information Agency, and were 13.4 million tons in 2015. More recent totals are not available, however, we know from RGGI COATS just for the electric power sector, Delaware emissions fell another 0.85 tons by 2017. So, the maximum 2017 total energy emissions in Delaware were likely no higher than 12.55 tons, a 28% reduction. The planned additional RGGI reduction to 2,460,591 tons by 2030, an additional 24% reduction, is no longer needed.

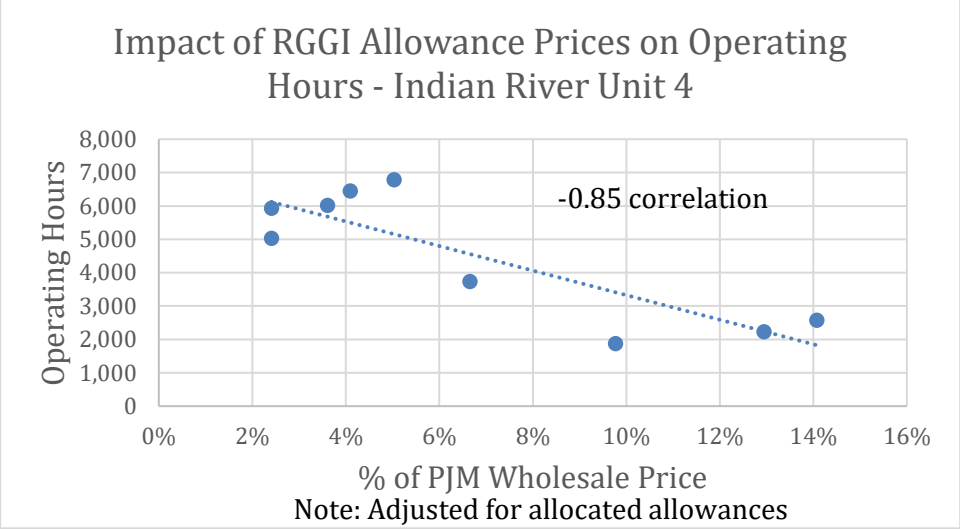
RGGI extension likely to simply export emissions to other states

Proponents of the RGGI program like to point to the dramatic decrease in power plant emissions since 2007 as proof of success. My peer reviewed report published in the winter 2018 Cato Journal, "A Review of the Regional Greenhouse Gas Initiative", attached as Appendix 1, shows the RGGI states merely mimicked reductions seen across the country in reaction to lower natural gas prices (72% of impact) , and a slew of new regulations promulgated by the EPA (28% of impact) during the Obama Administration. Well, the "war on coal" is over with the repeal and revision of EPA regulations, and the price of natural gas is expected to rise 17% over the next decade according to the US Energy Information Agency (EIA), "Annual Energy Outlook 2018" Table A3. Further reductions from these sources are unlikely.

My report also concludes the nine RGGI states cumulative power imports increased from 7% to 17%, goods production fell 12%, and energy intensive goods production fell 34%. Comparison states increased goods production by 20 percent and only lost 5 percent of energy intensive manufacturing. Basically, the RGGI states exported emissions to other states by importing power, and exporting manufacturing. I expect essentially all the expected emission reductions from the RGGI extension will come from increasing power imports, and shifting additional manufacturing out-of-state.

About half the planned reductions through 2030 will come from the likely closure of the Indian River power plant in Millsboro. My report, "Carbon dioxide cap and trade dramatically lower power plant efficiency, and increase emissions", attached as Appendix 2, shows rising RGGI allowance prices reduces operating hours at coal-fired power plants. The specific impact on the Indian River power plant is shown in Chart 1 below. A report by ICF International, "Draft 2017 Model Rule Policy Scenario Overview", September 25, 2017, for RGGI, Inc., estimates allowance prices will rise from a current price of about $4/ton to between $12.50/ton, and $24/ton by 2030. It is likely, at current PJM wholesale prices, Indian River stops operating at a $6 to $8/ton RGGI allowance price, a price likely to be reached in the early 2020s. The loss of Indian River may cause reliability problems. It is the only power plant south of Dover, and it is the only power plant in the state with significant on-site fuel storage. Indian River is the only coal-fired power plant left in Delaware, and offers fuel diversity as all the rest of the baseload power here is natural gas-fired. Intermittent solar power provides about 2% of in-state power generation.

Chart 1



Source: RGGI COATS, PJM annual average wholesale prices, DNREC 1147 code history

Importing more power from out-of-state will increase electricity costs

My report, co-authored with Dr. John Stapleford, "Cost Impacts of 2013 RGGI Rule Changes in Delaware", attached as Appendix 3, shows how indirect costs are added to electricity prices along with the direct cost of RGGI allowances. The report found, "Indirect costs arise from higher prices for Delaware generators making local power generators uncompetitive in regional power markets thus, lowering local power generation. Importing power results in higher electric prices from a series of pricing penalties from the regional electric grid manager, PJM Interconnection, including transmission congestion charges and line loss charges from longer transmission distances."

RGGI allowance revenue in 2017 was almost $10 million. If the 2030 RGGI emissions goal is met, and the ICF allowance price forecast is correct, RGGI revenue will rise to between $30 -- $59 million. Indirect costs may add another $10 million (4,120,000 megawatt-hour imports X $2.50/megawatt-hour). The total cost to a residential customer could be $45 to $75 a year for residential customers, and up to $500,000 a year for some industrial customers.

The Regulatory Impact Statement (RIS), Regulatory Flexibility Analysis (RFA) filed with the proposed regulation is flawed

DNREC did not submit a thorough Regulatory Flexibility Analysis (RFA) and a Regulatory Impact Statement (RIS) as required by the Regulatory Transparency and Accountability Acts of 2015. The Act requires state agencies to consider impacts to individuals and small businesses (up to $10 million annual sales). The RIS states benefits are neutral to slightly positive for the regulation based on a report from the Analysis Group. The key assumptions by the Analysis Group are the cost of RGGI allowances flow through to electric customers, but are offset by savings from allowance revenue spending on energy efficiency improvements that lower electric demand. The second assumption further assumes RGGI revenue was spent on energy efficiency projects, and the programs were effective. No other costs were considered.

As best we can tell from DNREC reports to the Delaware Legislature, and financial reports from the Sustainable Energy Utility, only about 30% of the RGGI revenue has been spent on energy efficiency programs, with another 20% spent on administrative expense, and another 50% sitting unspent. Almost none of the 30% spent on programs has been audited by actual weather adjusted meter readings, the only truly reliable means of determining energy savings. That is a far cry from the 70% estimate of RGGI revenue spent on energy efficiency improvements by the Analysis Group.

The issue of low actual spending on energy efficiency is not unique to Delaware. New Hampshire rebates 75% of RGGI allowance revenue to electric customers. Maine has about $75 million in unspent RGGI revenue out of $96 million received to date. Connecticut built up unspent funds, and now transfers all RGGI revenue to the General Fund. New York has transferred millions of RGGI revenue to its General Fund. Maryland spends about half its RGGI allowance revenue paying utilities to cover bad debt.

If the Analysis Group were right about RGGI revenue leading to better energy efficiency we would expect Energy Intensity, the amount of GDP produced for each unit of energy, to have increased faster in RGGI states than in comparison states. The opposite is true. In Appendix 1, page 10, Table 4, we show Energy Intensity in non-RGGI comparison states improved 11.5% compared to 9.6% in RGGI states.

We demonstrated above how direct and indirect costs increased electric prices. We also submit Delaware has lost half our energy intensive businesses resulting in the loss of high paying blue collar jobs thanks to higher electricity costs due in part to RGGI allowance costs. The U.S. Census Bureau, from its Annual Current Population Survey, Social and Economic Supplements, reports Median Household Income dropped by over $5,000 a year, while nationally household incomes grew by almost $1000 a year between 2007 and 2015. DNREC needs to redo the RIA using realistic assumptions. Clearly, RGGI costs are higher than its benefits. A more exhaustive analysis should be demanded to include:

- A citation to the Analysis Group study
- Proof RGGI revenue was actually spent on energy efficiency measures to the extent assumed by the Analysis Group
- Proof the energy efficiency programs delivered the expected results
- Include an analysis of the impact of lower electric demand on prices based on the inelasticity of electric rates for individuals and small businesses who often cannot relocate for lower rates
- Include the cost of jobs lost in Delaware because of higher electric rates
- Include the indirect cost of higher electric rates caused by PJM congestion and line charges being added to increased imports of electricity from out-of-state (Levitan Associates estimated about $2.50/MWh in its offshore wind study for the Maryland PSC, and we concur)
- Include the value of lost electric grid reliability from the reduced electric generation of Sussex County's only electric generation facility, the loss of the state's only generating facility with on-site fuel storage, and the loss of fuel diversity (higher allowance prices may cause the closure of the Indian River power plant in the early 2020s leaving us 100% reliant on natural gas for baseload power)
- Include the indirect and induced economic impacts of all of the above

DNREC's RFA gave no consideration to alternative ways to meet the emission reduction goals without raising electric rates for individual or small businesses. For example, New Hampshire refunds 75% of RGGI revenue to electric customers.

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Appendix 1

A Review of the Regional Greenhouse Gas Initiative

David T. Stevenson

The nearly decade-old Regional Greenhouse Gas Initiative (RGGI) was always meant to be a model for a national program to reduce power plant carbon dioxide (CO_2) emissions. The Environmental Protection Agency (EPA) explicitly cited it in this fashion in its now-stayed Clean Power Plan. Although the RGGI is often called a "cap and trade" program, its effect is the same as a direct tax or fee on emissions because RGGI allowance costs are passed on from electric generators to distribution companies to consumers. More recently, an influential group of former cabinet officials, known as the "Climate Leadership Council," has recommended a direct tax on CO_2 emissions (Shultz and Summers 2017).

Positive RGGI program reviews have been from RGGI, Inc. (the program administrator) and the Acadia Center, which advocates for reduced emissions (see Stutt, Shattuck, and Kumar 2015). In this article, I investigate whether reported reductions in CO_2 emissions from electric power plants, along with associated gains in health benefits and other claims, were actually achieved by the RGGI program. Based on my findings, any form of carbon tax is not the policy

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David Stevenson is Director of the Center for Energy Competitiveness at the Caesar Rodney Institute. He prepared this working paper for Cato's Center for the Study of Science. He thanks Pat Michaels and Jim Dorn for helpful comments on earlier drafts.

to accomplish emission reductions. The key results are:

- There were no added emissions reductions or associated health benefits from the RGGI program.
- Spending of RGGI revenue on energy efficiency, wind, solar power, and low-income fuel assistance had minimal impact.
- RGGI allowance costs added to already high regional electric bills. The combined pricing impact resulted in a 12 percent drop in goods production and a 34 percent drop in the production of energy intensive goods. Comparison states increased goods production by 20 percent and only lost 5 percent

of energy intensive manufacturing. Power imports from other states increased from 8 percent to 17 percent.

The regional program shifted jobs to other states. A national carbon tax would shift jobs to other countries. A better policy to reduce CO_2 emissions is to encourage innovation rather than rely on taxes and regulation. The United States has already reduced emissions 12 percent from 2005 to 2015, more than any other developed country with a large economy, mainly through innovations in natural gas drilling techniques. There are many other opportunities to invest in innovation, for example, improved solar photovoltaic cells, more efficient batteries, small modular nuclear reactors, and nascent technologies that use fossil fuels without emitting CO_2.

Background

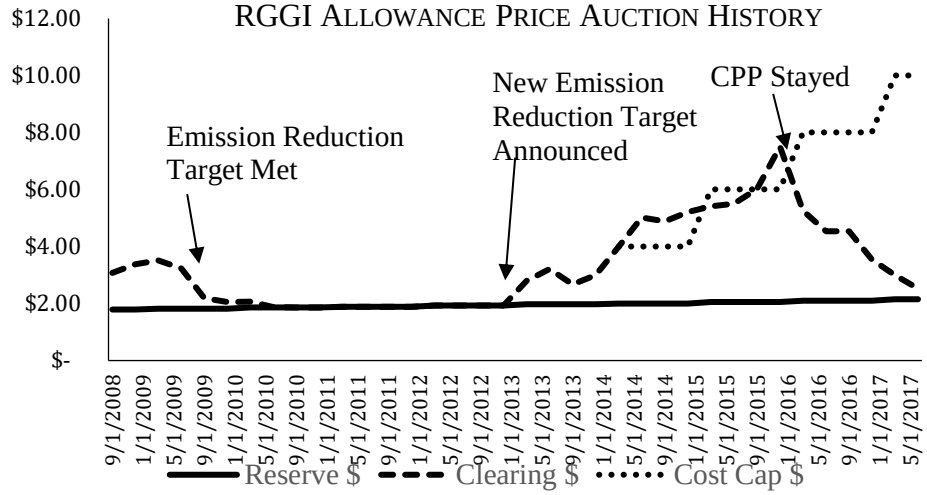
Ten northeast states joined together to form the RGGI to require power plants with a capacity of more than 25 megawatts to buy emission allowances for each ton of CO_2 emissions. The states included Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont. The allowances were sold in quarterly auctions beginning in 2008. The initial plan was to gradually reduce the number of allowances available to achieve a 10 percent emission reduction by 2018. New Jersey dropped out of the plan in 2011. In 2013, RGGI, Inc. announced plans for a 45 percent reduction in the number of allowances available in auctions beginning in 2014, with an additional 2.5 percent reduction each year until 2020 (Brown, 2013: 1). Consequently, allowance prices began to rise, and RGGI states are now negotiating an extension to 2030, with an additional 30% reduction in allowable emissions.

The program is touted by RGGI, Inc. as a market-based system. However, the program applies a minimum reserve price and a Cost Cap Reserve that kicks in additional allowances if an annual price cap is exceeded (Figure 1). The proposed agreement for 2030 also includes an Emissions Containment Reserve whereby states can withhold allowances if auction prices fall below a set target price. A true market-based cap and trade program would allow the market to set the price. Allowance prices averaged about $3/ton

from 2008 to 2013 ranging from about $2 to $4. In 2014, there was a dramatic cut in the number of available allowances that forced prices to a high of $7.50/ton in 2015, tracking the Cost Cap Reserve target. Prices began to fall after the Clean Power Plan implementation was stayed by the Supreme Court, and hit $2.53/ton in June, 2017, compared to a reserve price of $2.15. The extension targets a $13/ton price in 2021, and $24/ton in 2030. Speculators have made up roughly one-quarter of allowance purchases, trading with compliance entities in a secondary market.

According to Hibbard et al. (2011:15), in a report for the Analysis Group, "Within the electric system, the impacts of these initial (RGGI) auctions show up during the 2009–11 period, as power plant owners priced the value of CO_2 allowances into prices they bid in regional wholesale prices." A flow diagram in that report (p. 22) shows how the auction costs flow from the electric generators to the electric distributors, and on to consumers, the same as a direct tax or fee would do.

FIGURE 1
RGGI ALLOWANCE PRICE AUCTION HISTORY



SOURCE: RGGI, Inc., Auction Results.

In order to claim success for RGGI, the first cap and trade program in the United States, we need to consider some related issues:

1. Can the measured emission reductions be accounted for by non-RGGI causes?
2. Can the impacts on the economy be clearly broken down into statistically confirmable independent (RGGI inputs) and dependent variables (real GDP, or electric price changes)?

3. Can the RGGI revenue expenditures be shown to have been necessary and to have had significant impacts?
4. Were energy efficiency project claimed savings rigorously tested by weather-adjusted "before and after" meter readings?

RGGI fails to answer these questions. Unfortunately, the data needed for a robust statistical analysis (question 2) are not readily available and obtaining them is beyond the scope of this article. The other three are noted in the text that follows.

Electricity Demand

The change in electricity demand, by necessity, must consider the interplay of real economic growth, the details of that growth, changes in population, the impact of pricing, and of changes in energy efficiency. The RGGI program has an impact on these parameters.

It is difficult to compare electric prices from state to state because of significant regional differences in power cost. Also, at roughly the same time RGGI started, many states began requiring increased use of energy sources like wind and solar in their Renewable Portfolio Standard (RPS) laws, and set energy efficiency requirements.

A further complication is a number of states deregulated the supply portion of electric bills allowing market competition just prior to the start of the RGGI program. All the RGGI states deregulated. Fortunately, there is a comparison sample of five non-RGGI states (Illinois, Ohio, Oregon, Pennsylvania, and Texas) that deregulated electric supply in a manner similar to the RGGI states, and also had significant RPS requirements. Both RGGI and non-RGGI states have wide variation in their RPS programs, which adds uncertainty. Increasing wind and solar power raises electric rates because they are premium-priced power sources. For example, the increase in Delaware's electric prices by 9 percent is directly related to the RPS, which shows up on consumers' Delmarva Power electric bills. Likewise, Maryland electric bills have

increased 14 percent for the same reason, according to a report from the Maryland Energy Administration (Tung 2017: 17).[1]

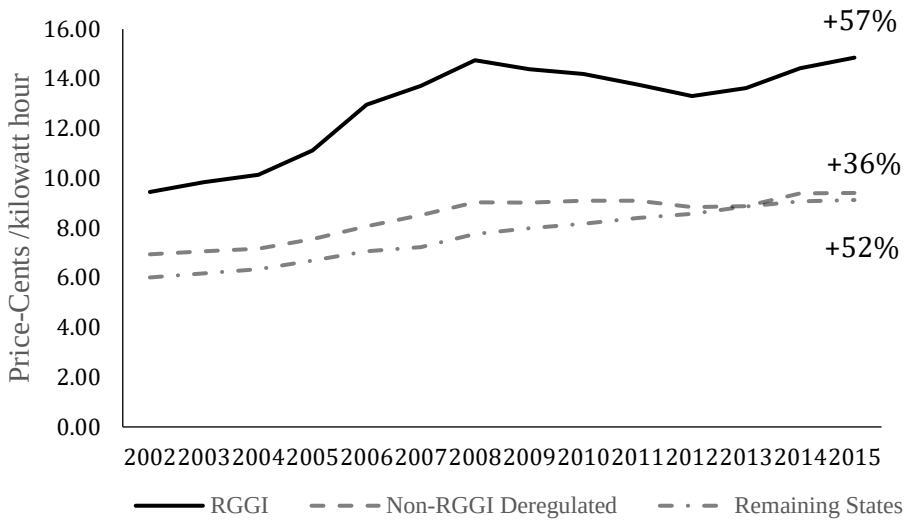
Non-RGGI comparison states actually added more wind and solar generation than RGGI states: adding 5.5 percentage points to generation compared to 2.3 percentage points in the RGGI states. Even removing the large wind farm construction effort in Texas from the calculation, the non-RGGI comparison states still outperformed the RGGI states: adding 3.4 percentage points compared to 2.3. The cost of wind and solar power has averaged two to three times the megawatt-hour rate compared to existing conventional fuel sources. The price impact should be greater in the non-RGGI states. Despite this disadvantage, the non-RGGI states still had lower overall price increases.

Several states that offered limited deregulation were not included in the comparison, and New Jersey is not included as a RGGI state because it dropped out of RGGI in 2011, and California is not included because it began a carbon tax just a few years ago. The results shown in Figure 2 cover the period from 2002 to 2015 to capture the impact of the four policies taken together (deregulation, RPS, energy efficiency, and RGGI).

To more accurately isolate the impact of RGGI between 2007 and 2015, the weighted average of total electric revenue for the multistate groups is used in Table 1, and shows RGGI prices rose 64 percent more than comparison states. The increase was split between direct RGGI cost pass-though and indirect cost. Direct emission allowance cost was $436 million in 2015, about half the price differential between RGGI and comparison states. The rest of the difference

[1] I use 2007 as the base year through 2015, unless otherwise noted. The reason for using 2007 is that RGGI auctions began in 2008, which was also the first year of the Great Recession.

FIGURE 2
ELECTRICITY PRICE TRENDS 2002 TO 2015



SOURCE: U.S. EIA (2016a) Detailed State Electricity Data, 1990 to 2015.

TABLE 1
WEIGHTED AVERAGE NOMINAL PRICE CHANGE 2007 VS. 2015

	Electric Revenue $Billion 2007	Electric Revenue $ Billion 2015	Demand Million MWh 2007	Demand Million MWh 2015	$/MWH 2007	$/MWh 2015	% Change
RGGI	$50.8	$51.4	353.7	342.4	$143.51	$150.14	+ 4.6%
Non-RGGI	$77.1	$81.3	851.9	873.8	$90.51	$93.01	+ 2.8%
U.S.	$343.7	$391.3	3482	3759	$98.71	$104.11	+ 5.5%

SOURCE: U.S. EIA (2016a) Detailed State Electricity Data, 1990 to 2015.

may be due to indirect RGGI costs. For example, when power is imported to Delaware and Maryland from the PJM Regional Transmission Organization there are premium charges for transmission distances, transmission congestion, and capacity charges. An earlier study, "Cost Impacts of 2013 RGGI Rule Changes in Delaware" (Stevenson and Stapleford 2016: 2), demonstrates RGGI allowances directly added $11 million a year to Delaware electric bills, while the indirect costs added another $28.5 million.

Prices in RGGI states rose concurrent with more energy intense manufacturing segments of the economy leaving the RGGI states with slower overall real economic growth based on Regional Real Chained GDP (Table 2). Linking real economic growth to RGGI alone is fraught

TABLE 2
REAL GDP GROWTH, 2007–15
(Billions of 2009 Dollars)

	Energy Intensive Goods		Total Goods		Total GDP		
State	2007	2015	2007	2015	2007	2015	Change
Connecticut	22.2	6.1	50.9	32.6	246.1	228.5	−7.1%
Delaware	4.1	2.2	8.3	6.5	57.6	60.5	5.0%
Maine	2.7	1.7	9.1	7.3	51.5	51.1	−0.8%
Maryland	9.0	7.9	35.8	33.3	301.3	322.0	6.9%
Massachusetts	11.8	11.8	61.3	59.9	391.0	437.6	11.9%
New Hampshire	1.2	1.1	10.6	9.9	62.4	64.9	4.2%
New York	36.1	26.5	117.1	107.1	1,153.5	1,265.6	9.7%
Rhode Island	1.1	1.3	7.1	6.2	49.7	49.7	0.0%
Vermont	0.8	0.6	4.7	4.2	25.8	27.2	5.7%
RGGI Total	89.1	59.2	304.7	267.0	2,338.8	2,507.3	7.2%
Illinois	32.4	36.7	125.9	120.5	671.1	686.0	2.2%
Ohio	32.3	36.7	121.1	123.4	510.6	543.4	6.4%
Oregon	5.1	5.4	47.0	59.5	173.1	200.4	15.8%
Pennsylvania	40.1	35.4	113.4	126.6	528.1	644.9	22.1%
Texas	91.8	91.8	344.7	471.1	1,166.7	1,492.8	27.9%
Non-RGGI Total	201.8	194.0	752.1	901.1	3,049.5	3,567.5	17.0%
U.S. Total	784.3	737.3	2,936.2	3,090.2	14,798.4	16,094.5	8.8%

SOURCE: U.S. Bureau of Economic Analysis, Interactive Tables.

with problems: real economic growth rates in RGGI states between 2007 and 2015 varied widely from a negative 7.1 percent for Connecticut to a plus 11.9 percent for Massachusetts. Can we realistically claim RGGI helped Massachusetts but hurt Connecticut at the same time?

The comparison states economies grew 2.4 times faster than the RGGI states. Data from the U.S. Bureau of Economic Analysis show that the RGGI states lost 34 percent of energy intensive businesses (primary metals, food processing, paper products, petroleum refining, and chemicals), the comparison states only lost 5 percent. The RGGI states lost 12 percent of overall goods production, while the comparison

states grew by over 20 percent. We see this impact show up in industrial electric demand with the RGGI states falling 18 percent, while non-RGGI comparison states only fell 4 percent (Table 3).

TABLE 3
INDUSTRIAL ELECTRIC DEMAND
(Millions of Megawatt-Hours)

	2007	2015	Difference	% Change
RGGI States	52.4	43.1	9.3	−18 %
Non-RGGI States	274.6	264.2	10.4	−4%
U.S.	1,027.8	986.5	41.3	−4%

SOURCE: U.S. Energy Information Agency Detailed State Electricity Data

Consideration also needs to be given to energy efficiency improvements as shown by the improvement in energy intensity (Table 4). RGGI states improved by 9.6 percent, while non-RGGI comparison states improved 11.5 percent. (Energy intensity improves when it goes down.)

TABLE 4
ENERGY INTENSITY, 2007 TO 2015

	Electric Demand Millions MWh		Real GDP $ Billions		Energy Intensity MWh/$ Million		
	2007	2015	2007	2015	2007	2015	% Change
RGGI	353.7	342.4	2,338.8	2,504.7	151	137	−9.6%
Non-RGGI	851.9	873.8	3,049.5	3,535.9	279	247	−11.5%
U.S.	3,764.6	3,759.0	14,798.4	16,089.0	254	234	−8.2%

SOURCE: author calculation dividing electric demand by real GDP

According to RGGI, Inc. (2016), RGGI states are investing the RGGI revenue in energy efficiency projects, suggesting RGGI states should be improving energy efficiency faster than other states. Based on gains in overall energy intensity this claim appears to be false. An explanation for this disparity may be that the funds are not going to energy efficiency, or that the energy efficiency projects may not be working well.

Both effects are seen in Delaware where 35 percent of allowance revenue is assigned to the Department of Natural Resources & Environmental Control (DNREC), and the rest flows through a private, nonprofit organization known as the Sustainable Energy Utility (SEU). Delaware has received $100 million in RGGI revenue: $55 million remains unspent and another $22 million has gone to administrative overhead and fuel assistance, with just $23 million (23 percent) going for energy efficiency projects.[2]

The Maryland Energy Administration (2016) reported that only 25 percent of RGGI revenue was allocated to grants for energy efficiency projects, and that doesn't take into account any money from the grants used for administration by the grantees.

Could the energy efficiency and renewable energy projects have been completed without the RGGI grants? The Maryland 2016 report, Appendix B, lists hundreds of projects receiving grants. Most of the renewable energy grants went to individuals or companies to install solar photovoltaic cells. The grants were small, running from $700 to $1,000 for residential systems that typically cost about $20,000. Solar projects receive federal tax credits, and the owners can sell renewable energy production credits to utilities that are required to buy them by state law, and receive full credit for every kilowatt-hour of energy produced from the local utility. Using a proprietary spreadsheet program, I find that the internal rate of return of a residential system falls from 10.6 percent with the state grant to 9.2 percent without the grant.[3] Most of the projects would move forward without the RGGI revenue grants.

In a report for the Delaware Department of Natural Resources & Environmental Control, Small (2012: 3) found that the federally financed "Weatherization Assistance Program," which receives 10 percent of RGGI revenue, was shut down for two years while all existing projects were reviewed and redone as needed after a federal audit found various quality control issues. This shows how state evaluation, measurement, and verification measures are not working

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[2] Calculation is based on information provided in an unpublished e-mail to a state senator of how DNREC spent RGGI allowance funds from 2014 to 2016, and from SEU Annual Reports (available at www.energizedelaware.org/sustainable-energy).

[3] I assume a 7,500 watt system @$2.85/watt cost with 20 year life, 9,000 KWh first-year generation reduced 0.5 percent per year, $0.1425/KWh electric rate rising 2 percent per year, $6 SREC value, and 30 percent federal investment tax credit.

The most rigorous test for energy efficiency projects is to check weather-adjusted meter readings before and after the project is implemented. I have found only one largescale study by Alberini, Gans, and Towe (2013) that did this. The authors found Maryland homeowners who replaced their heat pumps with no incentives saved an average of 16 percent on electric usage. Meanwhile, homeowners receiving cash incentives of $300, $450, and $1,000 or more had energy savings of 6.2, 5.5, and 0 percent, respectively. The authors concluded on page 7 that "the survey responses provide suggestive evidence the "rebaters" were disproportionately replacing "inadequate" units, leading us to conjecture that the rebates are being used to defray the cost of more powerful units, or of units that end up being used more.".

Table 5 shows predicted changes in electricity demand in the RGGI states based on the 2007 demand adjusted for economic growth (7.2 percent from Table 4), population change (1 percent from U.S. Census data), loss of goods production (−12 percent from Table 2), and efficiency improvements (−9.6 percent from Table 4). The actual demand fell 11 million megawatt-hours, close to the projected 14 million.

TABLE 5
PREDICTED CHANGES IN RGGI STATE DEMAND, 2007 –2015

Cause	%	Change in Demand, millions MWh
Economic Growth	+7.2%	+25
Population Growth	+1%	+4
Loss of Goods Producing Industry	−12%	−9
Overall Energy Intensity Improvement	−9.6%	−34
Net Theoretical Change		−14
Actual Change		−11

SOURCE: Author calculation multiplying the 2007 demand of 353.7 million MWh times the percentage change in the table, except lost goods production which comes directly from Table 3.

Impact on Carbon Dioxide Emissions

Emissions were reduced about 40 percent from 2007 to 2015 from electric generating units in the RGGI states (Table 6). That compares to only about a 20 percent reduction in emissions for the country as a whole and the comparison states, suggesting RGGI has been a success. As raw percentages, this would be true, but the base emissions of the RGGI states are much lower than the total for the country, so a relatively small change can appear as a relatively large percent.

TABLE 6
CO_2 EMISSIONS FROM POWER PLANTS, 2007–2015
(Metric Tons)

	2007	2015	Reduction	% Reduction
RGGI States	144,273,724	87,100,464	57,173,260	39.6
Non-RGGI States	635,998,529	511,342,562	124,655,917	19.6
US Total	2,547,032,486	2,031,452,263	515,558,023	20.2

SOURCE: U.S. EIA (2016a) Detailed State Electricity Data, 1990 to 2015.

Table 7 shows high CO_2 emission coal-fired generation *drops* 16 percentage points in both RGGI and non-RGGI comparison states, and natural gas *rises* virtually the same amount (10 for RGGI states versus 9 for non-RGGI states).

TABLE 7
GENERATION MIX PERCENTAGE CHANGE, 2007–2015

Fuel	RGGI 2007	RGGI 2015	Non-RGGI 2007	Non-RGGI 2015
Coal	23	7	48	32
Petroleum	3	1	0	0
Natural Gas	32	42	24	33
Nuclear	29	31	22	22
Hydro	10	12	4	3
Other	1	1	1	1
Wind & Solar	0	3	1	6
Biomass & Wood	3	3	1	1

SOURCE: U.S. EIA (2016b) *Electric Power Monthly*.

The non-RGGI comparison states actually added more wind and solar generation than the RGGI states (5.5 percentage points versus 2.3), even after allowing for a very large wind farm proliferation in Texas. Some RGGI auction revenue was invested in solar energy projects, but the RGGI, Inc. (2016) report identifies less than 100 MW of added solar capacity, which would account for only about 1 percent of the total wind and solar capacity added in the RGGI states according to generation data in the U.S. EIA *Electric Power Monthly*.

Another way to sort out the impacts of the RGGI program on emissions reductions is to review regulatory and market impacts to the generation mix and emissions in detail. The impacts of exporting emissions through the increased importing of power must also be considered. If a comparison is made of the

estimate of emission reductions using just factors common in all states, the comparison should isolate the impact of the RGGI program. The result of this comparison is discussed below and shows RGGI had no impact on emissions.

Delaware provides an early example of exporting emissions that can be found in a number of articles published in the *Wilmington News Journal* beginning in January 2008. On December 17, 2008, Delaware participated in its first regional cap and trade auction. Three weeks later the Valero-owned Delaware City Refinery announced the shut-down of its electric generation at the plant. According to RGGI, Inc. (2009), CO_2 emissions from the plants' electric generation facility accounted for 17 percent of Delaware's initial emission allocation. Valero had been gasifying petroleum coke, a waste product from the refinery, to fuel the power plant. Petroleum coke has emission rates similar to coal, but by gasifying it Valero reduced emissions of other air pollutants. So, three weeks into the RGGI program Delaware met its total 10 percent RGGI reduction goal. That isn't the end of the story. Valero sold the facility to PBF Energy. PBF restarted portions of the power plant fueled with conventional natural gas. The petroleum coke was loaded onto ships and sent to China to be burned directly for electric generation without pollution controls.

The RGGI states export CO_2 when they increase the import of electricity from other states. Between 2007 and 2015, the RGGI states doubled their imports (Table 8). Much of the imported power comes from the PJM transmission region. Adjusting for this factor decreases the RGGI state emissions reductions about 11 million tons.

TABLE 8
ADJUSTMENT OF RGGI STATE CO_2 EMISSIONS FROM IMPORTING MORE POWER
(Million MWh)

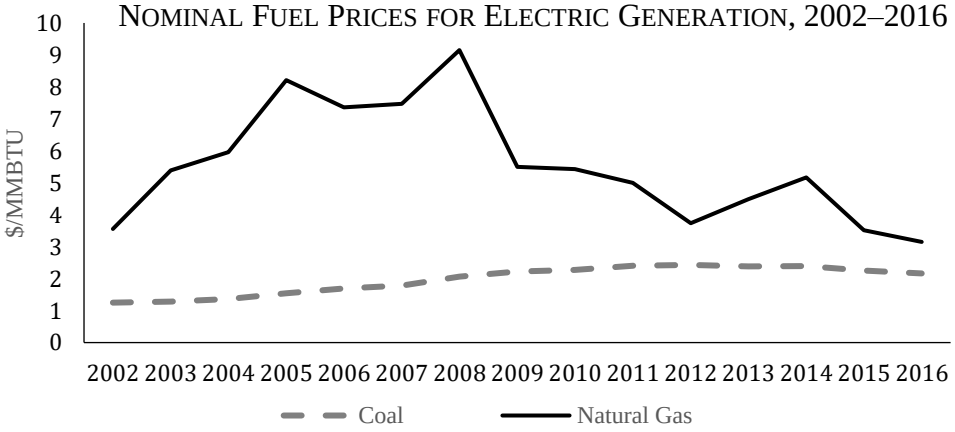
2007 Generation	2007 Demand	2007 Imports	2015 Generation	2015 Demand	2015 Imports	Change in Imports	Added MM tons CO_2
328.2	353.7	25.5	293	342.4	49.4	23.9	11

NOTE: Conversion of MWh to metric tons of CO_2 is PJM/EIS (2016) average emission rate of generation of 1,014 pounds/MWh in 2015 divided by 2,204.6 pounds/metric tons or 0.46.
SOURCE: U.S. EIA (2016a) Detailed State Electricity Data, 1990 to 2015.

CO_2 emissions are down across the country. A number of major EPA regulations have been implemented since 2009. Electric power plants have seen the most impact from regulation including the Mercury & Air Toxics Standard (MATS), the Cross State Air Pollution Rule (CSAPR), the Carbon Pollution Standard for New Power Plants that established New Source Performance Standards (NSPS), and the Clean Power Plan (CPP), all aimed at reducing the use of coal and forcing the closure of older, smaller power plants that were not worth upgrading with expensive new filtration equipment, given the low cost of natural gas.

The question is how much of the improvement in power plant emission reduction was caused by EPA regulations. As shown in Figure 3, nominal natural gas prices dropped significantly starting about 2009, driven by an increase in supply from the deployment of hydraulic fracturing and horizontal well drilling technology in shale formations. The types of coal used for electric generation have no other significant uses, and price tends to be stable because electric demand does not vary much from year to year. Natural gas has a number of high volume uses, such as, for industrial feedstock, and as a primary fuel for heating. Heating demand can vary significantly from year to year. For example, very cold temperatures in the winter of 2014 caused a spike in demand and price. Lower overall natural gas prices played a major role in the switch from coal to natural gas for electric generation starting in 2009, and regulations impacted generation capacity starting in 2012.

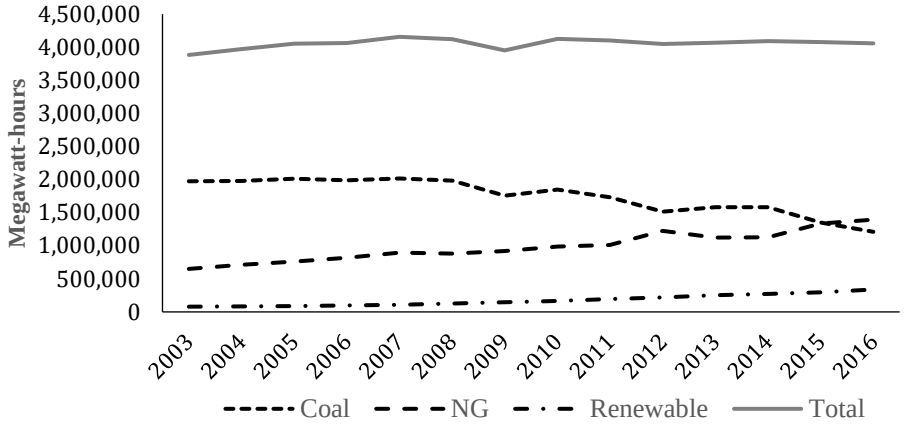
FIGURE 3
NOMINAL FUEL PRICES FOR ELECTRIC GENERATION, 2002–2016



SOURCE: US EIA (2016b) Electric Power Monthly.

Total electric generation was relatively constant since 2003, but increased almost 3 percent from 2009 to 2016 as the economy recovered from the recession (Figure 4). That increase in demand was met with wind and solar power growth driven by state Renewable

FIGURE 4
ELECTRIC GENERATION BY FUEL, 2003–2016

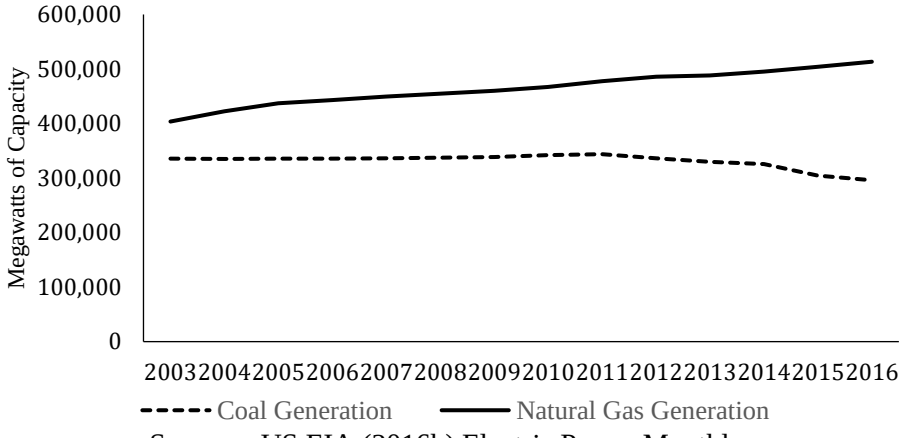


SOURCE; US EIA (2016b) Electric Power Monthly.

Portfolio Standards along with federal and state subsidies. Coal-fired generation was relatively constant until 2008, but began to fall in 2009. The fall paralleled declining natural gas prices. Natural gas generation has been increasing at a relatively constant rate.

EPA regulations did impact coal-fired generation capacity as shown in Figure 5. The downturn in coal capacity coincides with new regulation implementation beginning in 2012. Lower natural gas prices obviously influenced the decisions to close down the coal-fired generation.

FIGURE 5
ELECTRIC GENERATION BY YEAR, 2003–2016

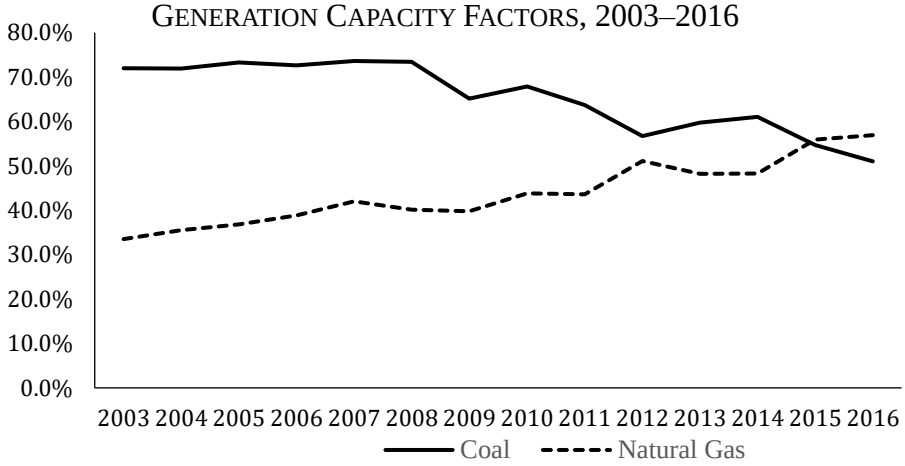


SOURCE: US EIA (2016b) Electric Power Monthly.

However, more important to coal-fired generation was the change in the capacity factor, that is, how often power plants ran in comparison to natural gas-fired power plants (Figure 6). The decline tracks the falling natural gas price curve that began in 2009.

With some certainty nationally, coal plant capacity reductions were caused by EPA regulations, and output reductions were caused by falling nominal natural gas prices. The impact of the two trends can be parsed. The computational details are provided in Stevenson (2017: 12). The result, both nationally and for the RGGI states, is an identical 28 percent from lost generation capacity, and 72 percent from lower natural gas prices. If the RGGI allowance program had a significant impact, it would have offset some of the impact of lower natural gas prices, because the allowance cost acts as an additional variable production cost, and would have

FIGURE 6
GENERATION CAPACITY FACTORS, 2003–2016



SOURCE; U.S. EIA (2016b) Electric Power Monthly.

shifted the ratio, but it didn't. This result is not unexpected as RGGI allowance revenue only averaged 0.6 percent of electric revenue between 2007 and 2015 ($0.3 billion/$51 billion).

To complete the estimate of emissions from common factors, the changes in natural gas-fired and petroleum-fired generation need to be added. Table 9 shows that the total net estimated reduction in emissions for RGGI states, due to factors common to all states, was 59.7 million

TABLE 9
CO_2 CALCULATED EMISSION CHANGE COMPARED TO ACTUAL, 2007–2015

Fuel	Est. Lost Generation Millions megawatt-hours	CO_2 Metric Tons/MWh	CO_2 Emission Reduction MM Metric Tons
Coal	56.0	0.928	−52
Natural Gas	18.2	0.439	+8
Petroleum	5.2	0.901	−4.7
Imported Power	23.8	0.46	−11.0
Calculated Reduction			59.7
Actual Reduction			57.2

SOURCE: Lost generation from U.S. EIA (2016b) *Electric Power Monthly;* emission rates from PJM/EIS (2016).

metric tons. That figure is slightly higher than the actual reduction of 57.2 million metric tons, which suggests that the actual reduction is accounted for without any significant additional contribution from the RGGI program.

Low Income Program

According to RGGI, Inc. (2016), in its report titled *The Investment of RGGI Proceeds through 2014*, 15 percent of RGGI revenue ($178.2 million) went to direct low income electric bill assistance to 2.6 million households from the beginning of the RGGI auctions in 2008 through 2014. The RGGI funds, about $30 million a year, were added to the federal Low Income Home Energy Assistance Program (LIHEAP). According to the U.S. Department of Health and Human Services (2014: 10–11), the federal government provided $795 million to RGGI states in 2014. Thus, RGGI added less than 4 percent to LIHEAP ($30 million annual RGGI contribution/$795 million federal contribution).

RGGI allowance revenue totaled $1.8 billion through 2014. The allowance program added $0.85/megawatt-hour to electric bills between 2008 and 2014 ($294 million a year/348 million megawatt-hours demand a year). RGGI state residential electric demand has been fairly flat, and averaged 130.9 million megawatt-hours/year. According to the U.S. Census Bureau (2010), there were 17.3 million households in the RGGI states. Thus, residential electric demand averaged 7.6 megawatt-hours per year (130.9/17.3). The total cost of RGGI equaled $6.50/household ($0.85 x 7.6). This reduces the net

contribution to low income households to $5/year ($11.50−$6.50). Therefore, the net RGGI contribution to the federal LIHEAP was only 1.6 percent, an insignificant amount.

Conclusion

In this article, I investigate claims by the Acadia Center (Stutt, Shattuck, and Kumar 2015: 6) and RGGI, Inc. (2016) that the RGGI program has generated significant benefits. Using data from five comparison states with similar overall electricity policies, except for RGGI, along with looking at national trends, I find the RGGI, Inc. and Acadia Center claims to be misleading.

The Acadia Center claims that compared to other states RGGI states increased electric prices by half as much, had 3.6 percent more economic growth, and reduced emissions 16 percent more leading to greater health benefits from pollution reduction. In reality, from 2007 to 2015, net weighted average nominal electricity prices rose 4.6 percent in RGGI states compared to 2.8 percent in comparison states. Linking real economic growth to RGGI alone is fraught with problems. Real economic growth rates in RGGI states between 2007 and 2015 varied widely from a negative 7.1 percent for Connecticut to a plus 11.9 percent for Massachusetts. Also average RGGI revenue only amounted to 0.01 percent of the combined average real GDP of the RGGI states, so one wouldn't expect much impact. Ignoring those difficulties, real economic growth was 2.4 times faster in comparison states than in the RGGI states. High RGGI state electric rates led to a 34 percent reduction in energy intensive industries and a 12 percent drop in the goods production sector, while comparison states saw only a 5 percent drop in energy intensive industries and a 20 percent gain in goods production.

This article finds there were no added reductions in CO_2 emissions, or associated health benefits, from the RGGI program. RGGI emission reductions are consistent with national trend changes caused by new EPA power plant regulations and lower natural gas prices. The comparison requires adjusting for increases in the amount of power imported by the RGGI states, reduced economic growth in RGGI states, and loss of energy intensive industries in the RGGI states from high electric rates.

The RGGI, Inc. report focuses on the impacts of spending the allowance revenue and suggests significant gains in energy efficiency, wind and solar investments, and assistance with low income energy bills. Noticeably, RGGI, Inc. does not make claims of superior emission reductions or lower power prices. In reality, the spending of the allowance revenue had marginal impacts. All states have shown energy efficiency gains. The RGGI states saw a lower improvement in energy intensity at 9.6 percent compared to 11.5 percent for comparison states, so there appears to be no RGGI-related gain in overall energy efficiency. Wind and solar energy installation was slower in RGGI states, only increasing by 2.3 percentage points, while comparison states grew by 5.5 percentage points, more than twice as fast. RGGI grants for wind and solar power only accounted for about 1 percent of all the wind and solar power added by the RGGI states. The net fuel assistance help for low income households, 15 percent of all households, only added 1.6 percent to the federal Low Income Home Energy Assistance Program, or less than $5/year. RGGI had no meaningful impact on lower income families. Meanwhile, the other 85 percent of households saw an increase in electricity cost of $6.50/year directly caused by the RGGI allowance cost.

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Appendix 2

RE: Carbon dioxide cap and trade dramatically lower power plant efficiency, and increase emissions

DATE : 4/11/2018 **David T. Stevenson, Director**

Experience with the nine state Regional Greenhouse Gas Initiative (RGGI) has shown it may actually increase emissions at power plants forced to purchase emission allowances by lowering operating efficiency by turning base load power plants into load followers with intermittent operation. I calculate a 13% decline in efficiency from lower operating hours, compared to a potential 6% gain from all energy efficiency strategies in the Clean Power Plan.

The latest RGGI auction is adding about $4.17/megawatt-hour to coal-fired Electric Generating Units (EGUs) in Delaware and Maryland. In addition, an Environmental Protection Agency spreadsheet calculates the cost to run Selective Catalytic Reduction (SCR) pollution control equipment under various operating conditions (also attached). Since RGGI began, the SCR operation costs may have risen by $2.45/megawatt-hour, and increased coal usage may have added another $0.54, for a grand total of $7.16/megawatt-hour in added costs. This is a significant amount considering the average PJM Delmarva Zone wholesale price in 2017 was $35/megawatt-hour, and leads directly to fewer operating hours and lower efficiency.

Merchant coal-fired Electric Generating Units (EGU) in two RGGI states, Delaware and Maryland, in the PJM Interconnection Regional Transmission Organization were reviewed. Table 1 provides the combined operating information for coal-fired Chalk Point, MD units 1 and 2, Dickerson, MD, units 1, 2, and 3, and Indian River, DE unit 4.

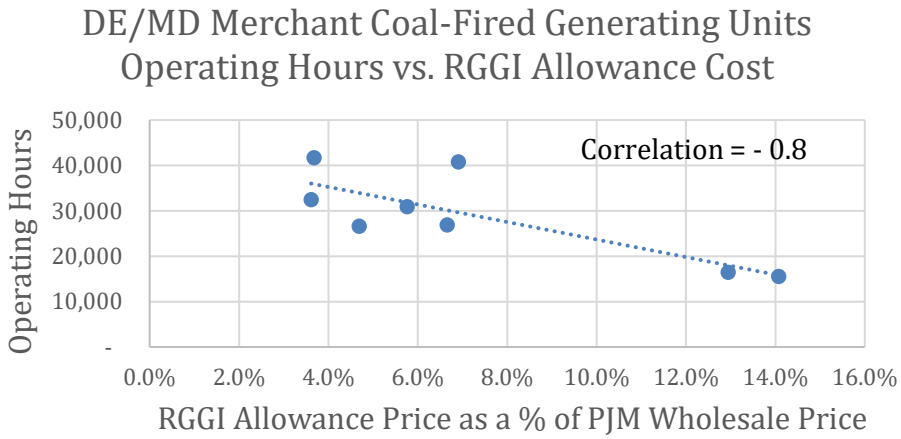
Table 1: Operating Information for six coal-fired EGU's in MD and DE

Year	MMBTU	MWh	Tons CO2	Heat Rate	tons CO2/MWh	Operating Hours	Efficiency
2009	77,892,841	8,339,131	7,985,161	9341	0.958	40750	36.5%
2010	83,006,579	8,492,233	8,721,474	9774	1.027	41701	34.9%
2011	62,291,965	5,759,548	6,390,655	10815	1.110	32428	31.5%
2012	43,386,334	4,108,110	4,401,386	10561	1.071	26261	32.3%
2013	51,535,606	4,745,005	5,280,418	10861	1.113	30877	31.4%
2014	48,906,883	4,480,833	5,141,322	10915	1.147	26898	31.3%
2015	27,507,453	2,394,986	2,621,515	11485	1.095	15534	29.7%
2016	27,930,508	2,335,968	2,816,511	11957	1.206	16466	28.5%

Source: MMBTU, Ton CO2, and operating hours are from RGGI COATS at https://rggi-coats.org/eats/rggi/index.cfm?hc=ISkgICAK , MWh are from US Energy Information Agency Form 923 at https://www.eia.gov/electricity/data/eia923/ , other columns calculated

Graph 1 uses information from Table 1, and shows how increasing RGGI emission allowance prices reduce operating hours. Coal-fired generation in non-RGGI states continued at about twice the RGGI state average.

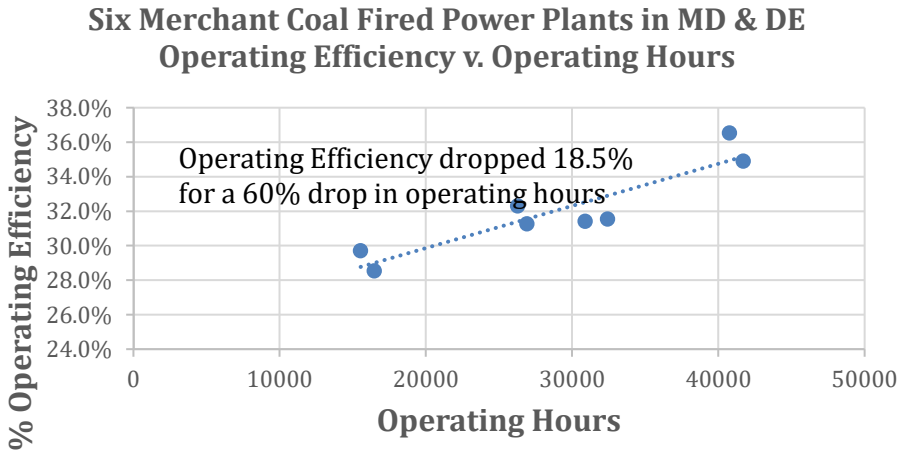
Graph 1



Graph 2 also uses information from Table 1, and shows operating efficiency falls approximately 18.5% when operating hours are cut 60%. In the Clean Power Plan estimates of potential energy efficiency improvements totaled about 6%, so the impact of lower operating hours is about three times as large as all other energy efficiency improvements combined! Lower operating efficiency increases CO_2 emissions. The Indian River Power Plant in Delaware saw a 32% rise in emissions per MWh from 2012 when each MWh emitted 0.87 tons of CO_2 to 2017 when each MWh emitted 1.15 tons. More coal was used to produce each MWh.

Lower operating hours over the period has two probable sources; the rapidly falling fuel cost of natural gas compared to coal, and the added cost of carbon dioxide emission allowances. According to the US Energy Information 2017 Agency Annual Energy Outlook, the national average Capacity Factor for coal-fired EGUs, the actual operating hours compared to potential operating hours, for coal-fired EGUs dropped from 65.1% in 2009 to 51% in 2016, or about 1235 hours in reaction to lower natural gas prices. Average operating hours at the six EGU's in Maryland and Delaware fell 4048 hours between 2009 and 2016. So, the ratio of hours lost because of lower natural gas prices to RGGI allowance cost is about 30% to 70%. Therefore, RGGI accounted for about a 13% decline in energy efficiency at the six EGU's (18.5% X 70%). EPA should consider expanding this study beyond six operating units.

Graph 2



Appendix 3

Cost Impacts of 2013 RGGI Rule Changes in Delaware
Co-authored By: David T. Stevenson & John E. Stapleford, Ph.D.
August 6, 2016

Executive Summary

Each electric generator in Delaware, over 25 megawatts in size, must buy permits to generate each ton of carbon dioxide released based on 2007 legislation establishing Delaware's participation in the Regional Greenhouse Gas Initiative (RGGI, 7 DE Administrative Code 1147). Quarterly auctions are run by RGGI, Inc. with nine states currently participating. This report describes how the electric generators pass the cost of the permits onto electric distributing companies, such as Delmarva Power and the Delaware Electric Cooperative, who in turn pass the cost onto electric customers. The report also considers the higher cost of permits resulting from reductions in the number of permits available, and of other RGGI rule changes promulgated by the Delaware Department of Natural Resources & Environmental Control through an Administrative Procedure in 2013.

In addition to the direct cost of the permits, indirect costs and benefits can be estimated. Potential indirect benefits arise from investment of RGGI revenues in energy efficiency and renewable energy projects that reduce carbon dioxide and air pollution yielding potential health benefits and economic benefits from potential lower sea level rise, and from lowering electric demand that might lower electric prices.

Indirect costs arise from higher prices for Delaware generators making local power generators uncompetitive in regional power markets thus, lowering local power generation. Importing power results in higher electric prices from a series of pricing penalties from the regional electric grid manager, PJM Interconnection, including transmission congestion charges and line loss charges from longer transmission distances.

Our conclusion, to reasonable degree of economic and electric industry certainty, is the 2013 RGGI rule changes increased direct electric rates in Delaware by $33.6 million between March of 2013, and March of 2016, or about $11 million a year. In addition, the net effect of indirect costs and benefits may have raised electric rates another $28.5 million a year for a total of $39.5 million a year in cost that is passed from generators, to distributors, to electric customers, or roughly $42 a year for residential customers. We note, higher electricity costs are an important consideration in the location decisions of certain business types, particularly manufacturing customers. With considerably less mobility, lower income households have to absorb higher electricity costs.

No offsetting benefits accrued from RGGI permit sale revenue. The revenue raised from the cost premium to permits from the new auction rules triggered by the 2013 RGGI regulation amendments sits unspent and will not likely be spent in the future.

Section I: The New RGGI Regulations Directly Influence Electric Rates Charged by Delmarva Power & Delaware Electric Cooperative to Consumers

The RGGI Auction Process

The regional cap and trade program began in 2007 with ten states agreeing to reduce carbon dioxide emissions from power plants by 10% by 2018. Power plants in these states would need to buy permits in quarterly auctions for each ton of emissions. Each state had an allotment of permits roughly equal to their average emissions between 2002 and 2006. The full permit allotment was to be auctioned through 2014, followed by a cut back of 2.5% a year through 2018. The cost of the permits is passed on to electric distributors who pass the cost on in electric bills. The auctions are run by RGGI, Inc. for a fee. New Jersey dropped out of RGGI in 2011. RGGI allotments, goals, and emissions by state are shown in Table 1.

Table 1: Original RGGI Cap and Trade Permit Budget – Million Tons

State	Original Budget	2019 Target Budget	RGGI 10% Reduction
DE	7,760	6,804	756
CT	10,696	9,626	1,070
MA	26,660	23,994	2,666
MD	37,504	33,754	3,750
ME	5,949	5,354	595
NH	8,620	7,758	862
NY	64,311	57,880	6,431
RI	2,659	2,393	266
VT	1,226	1,103	123
Total	165,185	148,667	16,519

Source: RGGI.org

The permits are offered in total with no specific designation of the state of origin. Bids for a number of permits at a specific price are submitted for the available permits by the required electric generating facilities (over 25 megawatts in size) prior to each auction. Electric generators are called Compliance Entities. Depending on market conditions, speculators can also bid for permits hoping to re-sell the permits in a secondary market at a higher price. The lowest price bid that covers the last available permits becomes the "Clearing" price and every winning bidder pays the Clearing Price.

A "Reserve" price was established as a minimum price in each auction with the price rising 2%/year. For example the Reserve Price for auctions in 2012 was $1.93. Between 2007 and 2012 auction prices ranged between $1.86 and $3.38. Compliance Entities must submit the permits by the end of three year Compliance Periods (2009-2011, 2012-2015, 2016-2018, etc.).

RGGI Costs Flow to Electric Bills

DNREC submitted a report as evidence in a lawsuit before the Superior Court titled "The Economic Impacts of the Regional Greenhouse Gas Initiative on the Ten Northeast and Mid-Atlantic States" published Nov. 15, 2011, and authored, in part, by its expert witness Susan Tierney who works for the Analysis Group. The report tracks how auction money flowed to the States, how it was used, and how the cost flowed from electric generators to electric consumers.

The authors concluded on page 15 "Within the electric system, the impacts of these initial (RGGI) auctions show up during the 2009-11 period, as power plant owners priced the value of CO_2 allowances into prices they bid in regional wholesale prices". A flow diagram on page 22 shows how the auction costs flow

from the electric generators to the electric distributors, and on to consumers. So, DNREC's own expert witness supports the fact RGGI auction costs show up on customer's electric bills.

Electric generating units that buy the allowances pass the cost on to electric distributors such as Delmarva Power, the Delaware Electric Cooperative, and municipal utilities. There can be an intermediate step between generators and distributors. For example, Delmarva buys power in three year contracts from Market Sellers, buying one third of estimated demand every year. The market Sellers buy from the generators and charge a premium for assuming the risks of market swings. The Market Sellers are adept at forecasting and pricing in all costs including RGGI permit fees, though there might be some lag time as contract costs catch up to RGGI CO_2 allowance increases.

On January 30, 2014, Stevenson received an e-mail forwarded by Bill Andrew, President/CEO of the Delaware Electric Cooperative from D. Richard Beam, Senior Vice President, Power Supply, for the Old Dominion Electric Cooperative. Old Dominion generates power and sells it to the Delaware Electric Cooperative. Mr. Beam stated RGGI cost, "Can and will be included in energy bid prices by ODEC". He further stated, "In reviewing the current ODEC RGGI costs, we are expensing about $100,000 per year, but that is expected to grow to about $500,000 per year as those costs are expected to grow". Mr. Andrew assures me the full supply cost of power, including those RGGI charges, are passed on in electric bills.

One of us (Stevenson) was an intervener in Public Service Commission Docket 13-250 regarding "Electric Bill Transparency", and attended workgroup sessions held by Delmarva Power. Delmarva Power has clearly stated in these workgroup meetings RGGI fees are being passed on to customers though they cannot be accurately tracked. Todd Goodman of Delmarva Power stated in a June 9, 2016 e-mail why it is so difficult to track the RGGI cost:

> "Delmarva does not generate electricity, it only delivers electricity. As a result, Delmarva does not purchase any CO2 allowances pursuant RGGI. Delmarva's customers can obtain their electric supply in one of two ways: (1) they can choose their own retail electricity supplier or (2) they can take SOS service.
>
> 1. If a Delmarva customer wishes to choose his own retail electricity supplier, he enters into a supply agreement with his chosen supplier. Delmarva is not aware of the particular sources of generation used by the various retail electricity suppliers.
> 2. If a Delmarva customer does not choose his own electricity supplier, then he is supplied with electricity by Delmarva through SOS (about 94% of power). Because Delmarva does not generate electricity, it acquires electricity to supply to its SOS customers through PSC regulated SOS auctions. The lowest bidders in the multiple bid tranches are awarded three year SOS electric supply contracts, which are reviewed and approved by the PSC. Delmarva is not aware of the particular sources of generation from which the winning SOS suppliers obtain their electricity.
>
> The electricity provided to Delmarva's SOS customers is sourced through PJM. Because the electricity provided to Delmarva's SOS customers is sourced through PJM, Delmarva's SOS fuel resource mix is the same as the PJM fuel resource mix. "Fuel resource mix" refers to, on an overall PJM basis: (a) the types of fuels used to generate electricity within PJM and (b) each fuel type's percentage of the total generation within PJM. Delmarva Power is required to inform its customers of the fuel resource mix for electricity supplied to its customers each year. I have attached a link to the most resent fuel resource mix bill stuffer provided to our customers."

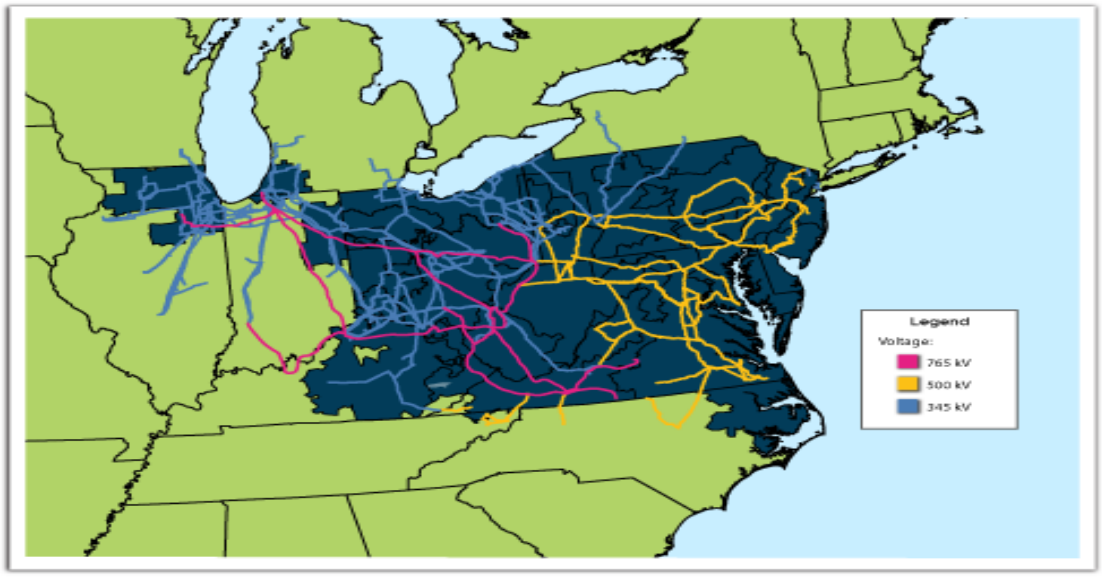
Following the link we find Delmarva's current fuel mix and 60% comes from carbon dioxide emitting sources (includes 40.5% coal, 19.4% natural gas, and 0.2% oil) all of which require permits if the power is generated in Delaware or Maryland. For power generated in Delaware in 2015, according to the US Energy Information Agency Electric Power Monthly for February 2016, 98% comes from carbon dioxide emitting fuels (includes 7.8% coal, 85.3% natural gas, 2% oil, 3% other gases).

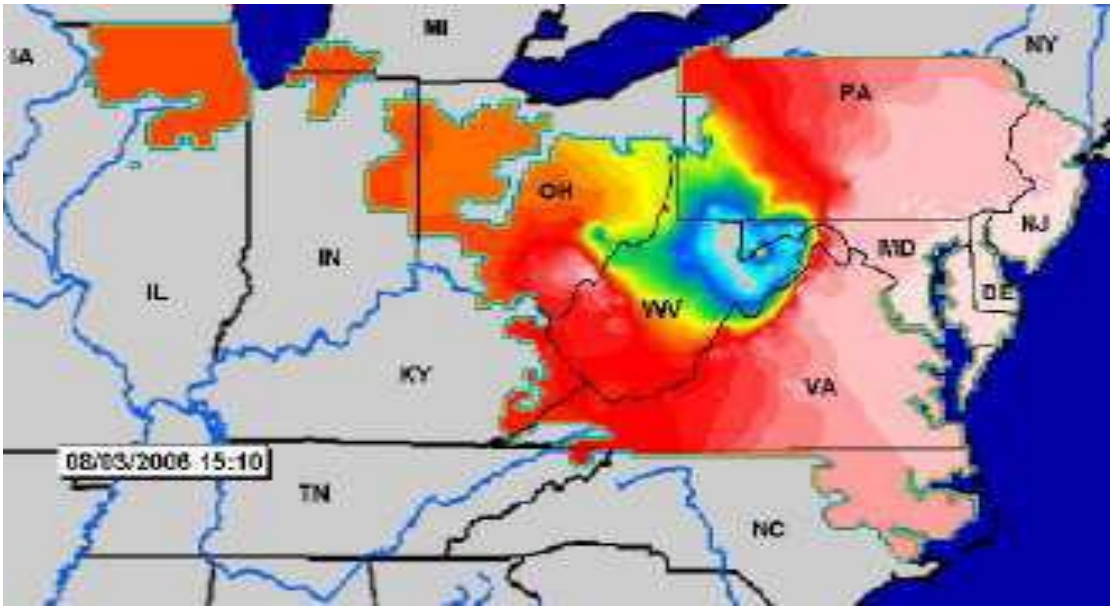
One of us (Stevenson) was also an intervener in Public Service Commission Docket 14-559, "Delmarva Power 2014 Integrated Resource Plan". On April 29, 2015, Delmarva Power filed a "Response of Delmarva Power Company to Comments filed by Intervening Parties". Two statements are pertinent:

- The IRP forecasts future electric rates. Delmarva asserted on page 10 they used a forecast price for RGGI permits of $4/ton in 2015, $6/ton in 2016, $7/ton in 2017, $8/ton in 2018, $9/ton in 2019, and $10/ton thereafter to allow for the impact of higher allowance prices on the price consumers will be forecasted to pay in the future.
- Further Delmarva's comments went on to concur, "Delaware EGU's (electric generating units) are able to purchase allowances offered in RGGI regional allowance auctions from any other RGGI state and use them for compliance purposes" confirming there are not Delaware specific permits.

We also must consider the way PJM Interconnection dispatches power. The maps below show the location of PJM Transmission Lines, and how power generation is distributed in the PJM network in a high demand period. The second map shows blue and green tinted regions in West Virginia and western Pennsylvania generate more power than is needed locally. The light pink areas in Delaware and parts of Maryland and New Jersey are importing power. Power moves from the west and north. When Delaware generators kick in the electrons move locally and south through the state dragging the cost of RGGI permits along to Delaware electric customers.

PJM Primary Transmission Line Map





Source: PJM Interconnection

Clearly the plaintiff's expert witness, Delaware electric distributors, and PJM distribution patterns all confirm the cost of RGGI permits required of Delaware electric generators flows to the electric bills of Delaware business and residential customers.

2013 Auction Changes

The Memorandum of Understanding between the RGGI states required periodic reviews by the Board of Directors comprised of members from each state. The 2012 review found auction revenue was much lower than originally expected.

A technical revolution in natural gas drilling technology combining horizontal drilling with hydro-fracturing of shale formations led to abundant natural gas. Prices for natural gas dropped from a high of $15/million BTU to as low as $2. Suddenly, natural gas fired electric generators became the cheapest way to produce electricity. Coal prices also dropped to compete.

At the same time new EPA regulations required additional investment to reduce pollution from coal fired electric generators. A wave of closings for coal fired generators was offset by a construction wave of new natural gas fired generators. Natural gas fired units emit about half the amount of carbon dioxide as coal fired units so the need for RGGI permits declined rapidly.

In Delaware, the closing of the electric generation facility at the Delaware City Refinery resulted in the state meeting the 2019, 10% carbon dioxide reduction goal two weeks after the first auction in 2007. Lower demand resulted in lower auction prices. Starting in 2010 RGGI saw auction prices fall to the reserve price for ten consecutive quarters.

The RGGI board announced recommended rule changes before the first auction in 2013. There would be a 45% reduction in the number of permits available starting in 2014, followed by a 2.5% reduction each year through 2019, a 53% total reduction from the original goal. The Reserve price would be increased each year by 2.5%. To protect electric rate payers from a rapid rise in prices, additional allowances were set aside in a Cost Containment Reserve (CCR) to be released if auction prices hit a trigger price with the trigger price rising each year. The trigger price is set at $4/ton in 2014, rising to $6/ton in 2015, $8/ton in 2016, $10/ton in 2017, and rising 2.5 percent/year thereafter.

A review of RGGI enabling legislation in each state shows slightly different requirements to approve changes in the RGGI program. In Maryland, Vermont, Connecticut, Rhode Island, and New York environmental regulators have clear authority to adopt the changes and did so. Maine, New Hampshire, Massachusetts, and Delaware required legislative approval. Maine and New Hampshire passed legislation. Massachusetts and Delaware regulators met objections to approval without legislative approval, but no litigation challenging the Massachusetts Department of Environmental Protection rules was filed. In Delaware, DNREC Secretary Collin O'Mara issued order 2013-A-0054, November 19, 2013, which immediately resulted in a legal challenge.

Reduced Permit Supply Results in Higher Auction Prices

RGGI, Inc. announced the rule changes in a press release dated February 7, 2013. They stated the new rules would increase auction revenue from $1.55 billion to $3.78 billion over the 2014 to 2020 period, an increase of $2.2 billion. DNREC repeated those numbers May 14, 2013 at a Workgroup Meeting on the RGGI rule amendments. This is exactly what one would expect from the economic law of supply and demand which states if the supply is reduced while demand remains the same, the price will increase. Every permit offered since the first quarter of 2013 has been bought.

The number of available permits dropped from 147 million in 2012 to 78 million in 2014, below the 88 million needed by electric generators to meet their expected emissions. However, speculators entered the market attempting to buy permits for resale at a higher price driving demand up to 202 million permits in 2014. This imbalance in supply versus demand raised prices from $1.93/ton in 2012 to $2.92 in 2013, $4.73/ton in 2014, and $6.10 in 2015. Table 2 shows how the supply/demand imbalance has driven up permit prices.

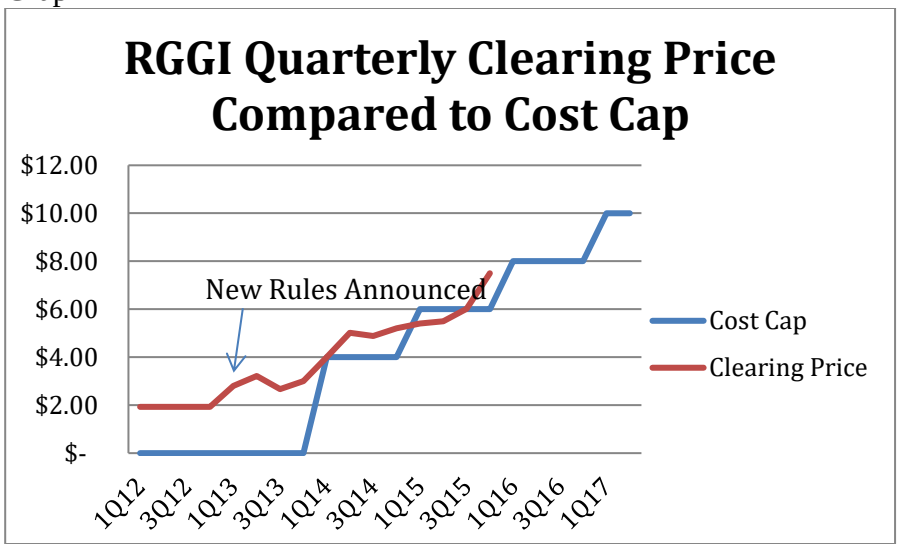
Table 2 RGGI Permit Supply, Demand, and Prices 2011 to 2015

Year	Available Permits-MM	Permits Bid-MM	Demand to Supply Ratio	Permits Sold-MM	Permits Needed-MM Based on Emissions	% Permits Sold to Compliance Entities	Permit Price -$/ton
2011	169.2	93.5	0.55	89.3	121	92	1.89[1]
2012	146.8	87	0.59	86.9	94.9	99	1.93[1]
2013	153.4	345	2.25	153.4	88.3	58	2.92
2014	77.8	201.6	2.6	77.8	88.3	67	4.72
2015	71.5	190.2	2.75	71.5	84.9	81	6.10

Source: RGGI.org Note 1: 2011 and 2012 sold at the Reserve Price

With demand far exceeding supply how were prices determined? The graph below, based on data from RGGI.org, shows how prices are rising in the quarterly auctions in direct relation to the cost caps. Basically, the RGGI States are setting auction prices.

Graph 1



The Direct Cost Increase of RGGI permits

Table 3 below shows the RGGI Revenue in Delaware from the first quarter of 2013 through the first quarter of 2016 with the impact of the rule change, and the estimate of what the cost would have been under the old rules assuming generators bought the number of permits they needed based on their emissions of carbon dioxide at the reserve price. The reserve price is used as the number of permits available would have greatly exceeded demand by about two to one. The direct impact of the RGGI rule change is estimated to be $33.6 million (actual revenue of $58.8 minus estimated revenue under the old rules of $25.2 million).

Table 3: Actual RGGI Revenue 1/12013 to 3/31/2016 vs. Estimated Revenue Under Old Rules

Year	Actual Revenue-$MM	CO2 Emissions-tons	Reserve Price-$	Est. Revenue Old Rules-$MM
2013	16.2	4,285,050	1.97	8.4
2014	18.0	3,937,000	2.01	7.9
2015	20.8	3,519,111	2.05	7.2
2016 1Q	3.8	803,980	2.09	1.7
Total	58.8			25.2

Source: RGGI COATS

Indirect Costs of the RGGI Rule Change

Electric supply and demand must be in absolute balance every second to avoid black outs and brown outs. PJM combines all electric generators and users over a thirteen state region. To ensure the lowest price and adequate reliability they use a Reliability Pricing Model described in PJM Manual 1, "Energy Ancillary Services Market Operations". PJM describes their philosophy on page 76, "The PJM scheduling philosophy in the Day-ahead Energy Market is to schedule generation to meet aggregate Demand bids that result in the least-priced generation mix, while maintaining the reliability of the PJM-RTO". Electric generators bid to supply power based on a PJM Day-ahead forecast. The lowest price that fulfills the forecasted demand becomes the Market Clearing Price and all lower bidders receive the Clearing Price. Actual demand is adjusted with bids every five minutes for incremental increases in generation which becomes the System Energy Price.

The System Energy Price is adjusted positively or negatively for the cost of system transmission congestion, and for transmission line losses for the distance power travels. The net cost is the Locational

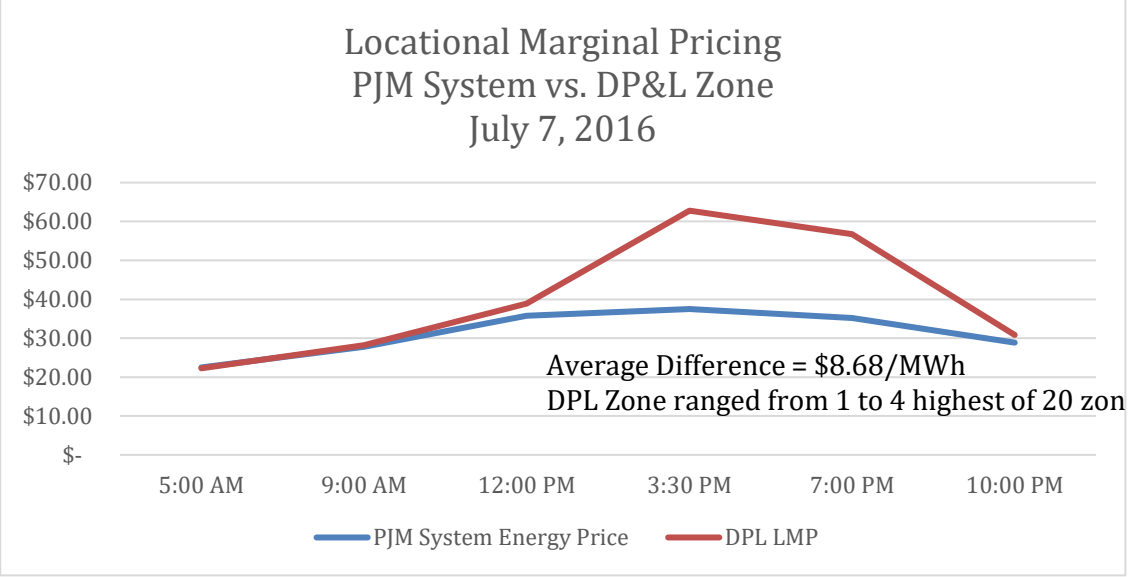
Marginal Price (LMP) for each of twenty zones, which can be seen in real time on the PJM website. Delaware is in the DPL Zone which is often the highest cost, or near highest cost zone in PJM because we are the fifth highest electricity importing state in the country – *i.e.* Delaware causes significant transmission congestion and line losses.

In 2015, RGGI added $6/megawatt-hour to the cost of coal fired electric generation in Delaware, or more than 15% of average PJM wholesale cost, with about half that impact added on natural gas fired power plants. This cost premium causes existing plants to operate less hours per year. In 2015, electric demand in Delaware was 11.4 million megawatt-hours but production was only 7.7 million megawatt-hours requiring the import of 32% of our power.

Existing generating units in Delaware are capable of producing all the power we need if RGGI price constraints are lifted. If Calpine's Edgemoor/Hay Road operating hours increased 29%, its new Dover unit operated for a full year, and the NRG facility doubled operating hours, existing units (still operating below demonstrated potential) would meet existing demand.

We estimate line loss and congestion charges are adding $2.50/megawatt-hour to electric rates in Delaware on an annual basis. The number could be considerably higher as demonstrated by Graph 2 below showing the premiums during the day of July 7, 2016. In 2015, RGGI induced operating constraints added about $28.5 million a year to electric bills for line losses and congestion.

Graph 2



Source: PJM Interconnection Real Time Statistic

Section I Conclusion

Our conclusion, to reasonable degree of economic and electric industry certainty, is the 2013 RGGI rule changes increased consumer electric rates in Delaware by $33.6 million between March of 2013, and March of 2016, or about $11 million a year. In addition, the net effect of indirect costs and benefits may have raised electric rates another $28.5 million a year for a total of $39.5 million a year in cost that passed from generators, to distributors, to electric customers, or roughly $42 a year for residential customers.

Section II – The Report Submitted by DNREC is Incorrect; RGGI Does Not Lower Electric Rates Charged by Delmarva Power & Delaware Electric Cooperative or Provide Indirect Benefits to Offset Higher Electric Rates

DNREC's expert witness claims RGGI revenue is used for multiple benefits including:

- Low income fuel assistance
- Jobs created from work on energy efficiency and renewable energy projects
- Health and social benefits from lower carbon dioxide emissions
- Lower overall electric rates from reduced electric demand
- Lower electric rates for those who directly use the funds for "green" energy projects

A number of arguments can be made to counter these supposed benefits including:

- Low income fuel assistance just about offsets higher electric prices caused by RGGI. The findings of the research literature on price and the consumption of electricity over the past 30 years has been consistent: the relationship is small. That is, demand is relatively inelastic to price. And demand is inelastic in both the short-run and long-run. There are few options available to the consumer in response to changes in the price of electricity. So the increase in electricity prices from the arbitrary cap imposed on permits will not reduce electric demand substantially in the long run. Higher electric prices will in the long run encourage households and businesses that are mobile to relocate.
- The principles of supply and demand apply throughout the U.S. economy, including the highly regulated electricity industry. There is no doubt that the final supplier will attempt to pass on to the final consumer the higher costs generated by CO_2 fees. And since demand for electricity is inelastic, the supplier will be able to transfer more of this additional cost to consumers due to lack of substitutes.
- The cost structure of the electric generation industry is a classic case of economies of scale. This means that any reduction in electric demand that reduces supply drives up the unit costs of electricity and will result in higher electric prices.
- The American Council for an Energy Efficient Economy advises not to assume job creation from energy efficiency projects as money is simply being re-directed from other parts of the economy. The same is true for renewable energy projects.
- Energy efficiency forecasts need to be tempered by offsets such as people who would have done projects anyway without RGGI grants, and the rebound effect where efficiency actually leads to more energy use. A University of Maryland study found grants for more efficient heating and air conditioning were completely offset by people opting to use the cost savings for warmer winter and cooler summer thermostat settings.
- Grants merely shift wealth from utility customer losers paying higher bills to grant winning winners, often upper income people.
- The Delaware auditor reviewed energy efficiency projects in state buildings and found savings were far below forecast.
- A Federal audit of low income weatherization projects found wide spread shoddy workmanship and incomplete work that led to a 100% redo of projects.
- A report for the Delaware Energy Efficiency Advisory Council estimated electric demand fell only 0.5 % in total from energy efficiency in Delaware from all known programs, not just RGGI based programs, over a four year period from 2010 to 2013. Such a small amount, about 0.1% a year, will have no impact on electricity prices. Electricity demand can vary +/- 5% a year just because of weather variability.

Competing experts could have a lively debate over how effective RGGI spending has been in providing the expected benefits, however the argument is a moot point. The more basic issue is the added revenue from the auction rule change has not been spent! There can be no benefit from unspent revenue, either from energy efficiency lowering demand, or from indirect benefits.

A DNREC response on May, 9, 2016, to an inquiry from state Senator Gregory Lavelle describes how much RGGI revenue was raised and how it was spent by DNREC administered programs. These results were combined with Financial Reports from the Sustainable Energy Utility (SEU) available on the Energize Delaware website to provide a complete picture of RGGI program spending during the period covered by the RGGI rule change and is shown below in Table 4.

Table 4: RGGI revenue and Spending 2013 Fiscal Year through May 9, 2016

RGGI Allocation	Type of Spending	Revenue - $	Expenditure - $
LIHEAP - 5%	Client Program	2,867,242	2,867,242[1]
"	Administration		
Low Income Weatherization- 10%	Client Program	4,465,727	2,979,190
"	Administration	893,757	893,757
DNREC Administration - 10%	Administration	7,851,725	2,253,245
DNREC GHG reduction – 10%	Client Program	7,851,725	800,000
Sustainable Energy Utility – 65%	Client Program	32,748,919	5,185,680
	Administration	2,087,725	2,087,725
	Loan		10,122,561[2]
Total Client Programs		47,933,613	21,954,673
Total Administration		10,833,207	5,234,727
Total		58,766,820	27,189,400

Notes: 1. Administrative costs requested but not received, 2. Loan is not an expense but an asset

Actual expenditures of RGGI funds totaled $27 million including $5 million for administrative overhead, $12 million for client programs, and a questionable $10 million in SEU loans. The SEU is authorized to borrow money in private equity markets with bonds free of state taxes, and loans were to be made from that source, not RGGI. The federal government, most state and local governments, and businesses regularly use money from private equity markets to fund energy efficiency projects. The SEU loans are not critical to energy efficiency projects moving forward in Delaware. The loans do allow the SEU to make their pot of unspent RGGI revenue look smaller, and offer the SEU a better rate of return on the unspent funds. However, loans are an asset, not an expenditure.

The $27 million in expenditures were covered by $12 million in unspent funds from prior years and $15 million in new RGGI revenue. Had DNREC not changed the auction rules there would have been about $25 million in revenue over the three year period leaving a net $10 million unspent! With the higher revenue from the auction rule change there is now $44 million left unspent.

Keep in mind the RGGI program is a decade old and DNREC and the SEU have still not figured out how to spend the revenue they were receiving under the old auction rules. There can be no expectation they will significantly improve performance in the future. Spending is at about a $7 million annualized rate, about what would be seen in revenue under the old auction rules. Annual revenue should continue at $20 million a year minimum and could go as high as $40 million using the contested new rules, so the trove of unspent funds will continue to grow.

To put the current $44 million in unspent revenue in perspective compare it to the entire state Bond Bill Budget for Fiscal Year 2017 of less than $30 million! The extra revenue from the new

auction rules has not been spent, and is unlikely to be spent in the future. There can be no benefits calculated from unspent funds.

Section II Conclusion

Our conclusion, to reasonable degree of economic and electric industry certainty, is no offsetting benefits accrued from RGGI permit sale revenue as the revenue raised from the cost premium to permits from the new auction rules triggered by the 2013 RGGI regulation amendments sits unspent and will not likely be spent in the future.